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CONTENTS

CEMA COOPERATION IN PESTICIDE HYGIENE, TOXICOLOGY OUTLINED

Prague MEZINARODNI ZEMEDELSKY CASOPIS in Slovak No 5, 1982 pp 43-45

[Article by Docent L. Rosival, M. D., DSc , Institute of Preventive Medicine, Bratislava: "Scientific-Technical Cooperation in Pesticide Hygiene and Toxicology"]

[Text] During the period 1976-1980, 30 research organizations in Hungary, East Germany, Romania, Poland, the Soviet Union, Czechoslovakia and Yugoslavia cooperated in CEMA topic 1-8. XI, "Pesticide Hygiene and Toxicology, Research on Possible Undesirable Consequences of Pesticide Use, and Development of Protective Measures."

The work plan for this topic during the period 1976-1980 included 68 research assignments, involving comprehensive hygiene and toxicologic study of pesticides with reference to protecting human health and the environment.

A special part of the topic was the tasks included in the integrated program of multilateral scientific and technical cooperation under CEMA problem V-2. The problems dealt with in these tasks involved monitoring and automatic testing for pesticide residues in foodstuffs and in the environment using computer systems.

The tasks in pesticide hygiene and toxicology focused on:

a. mutagenic, teratogenic and embryotoxic effects of pesticides and preparations under development;

b. circulation and accumulation of pesticides in biological material and the external environment;

c. interaction of residues of pesticides and their metabolites with important foodstuff components;

d. analysis of residues for the purpose of setting standards and norms.

The results of scientific cooperation between the member states in this field are an important contribution in terms of:

a. obtaining many-sided data for scientific evaluation of the side effects of the introduction of chemicals;

b. development of efficient measures for protecting human health and the quality of the environment;

c. providing information on ways of developing plant protection and on environmental problems in the individual member countries;

d. development of a multidisciplinary scientific approach to the solution of socially important problems.

Analytical Study of Pesticide Residues

In order to obtain qualitative and quantitative data for the development of hygienic and toxicologic norms and measures for protecting public health, all of the CEMA member countries carried on extensive analytical study of the dynamics of persistence of pesticides after their use in agriculture. Agricultural products, foodstuffs, milk, water, soil and the air were analyzed. Important data were obtained on the following active ingredients of pesticides: arprocarb, azinfos-methyl and ethyl, benfluralin [benefin], benomyl, bromfenvinfos, methyl-bromfenvinfos, chloridazon, chlormequat, dichlorvos, dicamba, demefion, demeton-methyl, dimethoate, dichloroisobutyric acid, dichlofluanid, DNOC [dinitrocresol], ethefon, etrimfos, thiscyclam, fenthion, fenitrothion, phosmet, phosalom, folpet, phenoxyalkane carboxylic acids, isopropalin, carbaryl (and 1-napthtol), carbendazim, kelevan, kepone, captafol, captan, lindane (and BHC [benzene hydrochloride] isomers), malathion, mancozeb (and ETU [ethylene thiourea]), methidithion, methoxychlor, copper, mercury, propyzamid, pendimethalin (fanoxalin), pirimiphos-methyl and ethyl, PCB [polychlorinated biphenyls], triazine herbicides, trifluralin, trimedefon, thiometon and trimorfamid.

Investigations of Residue Circulation and Accumulation

As part of the investigation of the circulation and possible transfer and accumulation of pesticide resideus, studies were made of the distribution and persistence of several pesticides of different groups in plant and animal substrates, soil, milk and eggs (Hungary, East Germany, Poland, Romania, Soviet Union, Czechoslovakia).

A direct relationship between the level of HCB [hexachlorobenzene] in chicken feed and egg yolk was confirmed. When feed containing 0.03 mg/kg of HCB was fed, the cumulative HCB levels in egg yolk over an 11-month period rose from 0.305 to 1.58 mg. kg. When livestock feeds contain residues of organophosphorus pesticides at levels between 0.1 and 0.2 mg/kg, these may appear in meat and milk (Czechoslovakia).

Extensive monitoring of milk and dairy products in East Germany confirmed that residues of chlorinated pesticides tend to drop. A survey of mother's milk from 13 kreise (225 samples) in 1979 gave the following values (values

relative to milk fat in parentheses): BHC 0.011 (0.306 mg/kg, total DDT 0.107 (2.97) mg/kg; HCB 0.033 (0.92) mg/kg; PCB 0.038 (1.06) mg/kg.

After administration of carbaryl to chickens, the level of carbaryl and 1-naphthol residues in the eggs did not exceed 0.03 mg/kg. After a single administration of Despirol to cows, the kelevan and kepone residues fell to the detection theshold after 28 days, while the maximum concentration occurred between the 3d and 7th days. After administration of 50 to 100 mg/kg of fenitrothion to cows in their fodder, the residue in the milk was below the detection threshold after 3 days (Poland).

An analytical study of 1,564 soil samples in Romania gave the following ranges of residue levels: lindane 0-0.5 mg/kg, DDT 0-0.7 mg/kg.

The study has confirmed that introducing DNOC into the soil transfers DNOC residues into root vegetables (Poland).

Development and Standardization of Methods for Analyzing Residues

As a result of multilateral cooperation, a draft unified analytical scheme for analyzing multiresidues of organophosphorous pesticides in a wide range of substrates has been developed. This draft has been approved by the Soviet Union. Its adoption as a standard method for all CEMA member countries is recommended. In addition, a proposal for a standardized method of analyzing residues of phenoxyalkane carboxylic acids and triazine pesticides in plants, soil and the air has been developed and has already been approved in the Soviet Union. A method for determining residues of phosmet (phthalofos) and chloridazon (pyramine) in water, biological materials and soil has been developed and put into use in the Soviet Union. In addition a procedure for determining chlorinated pesticides in the presence of PCB's (USSR) and a method of determining PCB's in the presence of chlorinated pesticides (Poland) have been developed.

The analysis of residues of chlorinated pesticides has been considerably shortened by a method of simplifying the purification of extracts, in which the flow of gas is treated in several gas chromatograph columns. In this connection, a semiautomic combined method of extraction and purification of extracts has also been developed in East Germany.

In connection with studies of the metabolism of benomyl and carbendazim in plants, a method of determining their principal metabolites, 2-amino-benzimidazole, benzimidazole and 5-hydroxy carbendazim has been developed. A gas chromatographic method of determining residues of camphechlor has been developed (East Germany).

In Poland, methods for determining residues of many insecticides, herbicides and fungicides in a wide range of agricultural products have gone into routine use.

Hungary has developed and put into use a system for processing the results of analytical monitoring of pesticide residues in foodstuffs and the environment which makes use of data processing equipment (EVT).

The Soviet Union has completed developir, the data base for a unified computer-based system of monitoring pesticide residues. Approval for the model system has been secured at the oblast level and in four republics, and measures in implementation of the first stage of a unified system have also been approved. In cooperation with East Germany and Poland, the USSR has developed the principles for sampling agricultural products and environmental sampling.

Yugoslavia has developed methods for determining sym-triazine herbicides and metabolites of phenoxyoctic acid and phenitrothion in soil and plants.

Toxicological Study of Pesticides

In investigating the delayed effects of pesticides it was found that the insecticides phoxim and tetrachlorvinphos may present potential danger to man, since they have a weak cytogenetic activity. A toxicological study of the Czechoslovak fungicide trimorfamid and the Polish pesticide RS-147 showed that both have little toxicity. A set of "Procedural Instructions for Toxicological and Hygienic Evaluation of New Pesticides" and a "Procedural Guide for Toxicological-Hygienic Study of Microbiological Plant Protection Substances" have been prepared in the Soviet Union and approved by the USSR Ministry of Health.

A study of the combined toxic effects of a mixture of parathion-methyl, carbaryl and lindane in Wistar rats for the purpose of clinical-biochemical evaluation of their main toxicological characteristics has been concluded. The ability of organophosphorus pesticides (butonate, trichlorphon, dimethoate and bromophos) to alkylate the DNA [deoxyribonucleic acid] of warm-blooded animals has been studied as a function of their solubility in water. Substances with a water solubility less than 0.1 percent (100 mg/kg) do not alkylate DNA. In contrast, dibrom proved to have a greater alkylating activity than dichlorvos. A comparative study of the effects of lindane and its derivatives on liver enzyme systems, and induction of cytochrome P-450 and on the effectiveness of ATP-ase [adenosine triphosphatase] in the liver, kidneys and brain has been completed. In addition, possible neurotoxic and organitropic effects have been studied in rats. The effects are a function of the chemical structure of the compounds in question. A study of embryotoxic and teratogenic properties of the fungicides tridemorph and aldemorph has been conducted. Passage of trichlorphon across the placenta has in white rats been confirmed by radiochemical and analytical methods and the presence of its conversion products (dichlorvos, trichloractaldehyde, dichloracetaldehyde, trichloroethanol) in embryonic and fetal tissue has been demonstrated (East Germany).

Interesting conclusions have resulted from a study of the effects of 34 pesticides on milk cultures and on the suitability of contaminated milk for the production of dairy products. It was found that dibrom is degraded in milk and in blood by dichlorvos (East Germany).

A study has been made of clinical-biochemical evaluation of the effects of trichlorphon on the activity of liver enzymes and induction of cytochrome P-450 (Yugoslavia).

Carbendazim labeled with C-14 was used to study excretion of the fungicide in the urine of rats as a function of the method of administration. Differences in excretion dynamics were found. Study of the embryotoxic and teratogenic effects of bromfenvinphos, chlorphenvinphos, ethenofon, carbendazim, lindane, butanate, captafol, methylmercury chloride and methylmercury acetate and a three-generation study of the effects of bromfenvinphos in rats aimed at determining the ineffective dose have been completed. The chronic effects of carbendazim and methyl-bromfenvinfos were studied in a 2-year experiment.

The mutagenic and carcinogenic properties of propoxur, carbaryl, carbendazim and their corresponding N-nitroso derivatives and metabolites has been conducted. Attention has also been devoted to the biochemical aspects of mutagenesis and carcinogenesis.

No conversion of mercury to methylmercury derivatives in the organs of rabbits after administration of methylmercury chloride, phenylmercury acetate and methylmercury chloride was demonstrated. But a positive result was obtained in rabbit tissues after administration of methylmercury chloride (Poland).

The concluding phase includes a comprehensive toxicological study of the Czechoslovak fungicide trimorfamid (Czechoslovakia).

Standards Activities

Hungary has developed and standardized public health norms (maximum permissible level, MDU) for total DDT, lindane and HCB in foodstuffs. Based on comments from the other states and discussion at the NKS [National Public Health Norms Meeting] in Budapest in 1980, East Germany and Poland have jointly developed a set of "Public Health Requirements for Registration of New Pesticides" for the CEMA member countries and Yugoslavia. The documents have been sent to the KOC [expansion unknown].

Poland has developed draft standard procedures for determining acute peroral and dermal toxicity and a draft procedure for establishing primary dermal and ocular toxicity. In addition, a draft procudure for establishing the mercury content of hair as an indicator of human exposure to mercury has been developed.

The Soviet Union has developed and established principles and methods for setting norms for pesticide concentrations in the soil. In addition, PDIS [maximum permissible concentrations] for several pesticides in the soil have been developed. PDK's for a number of pesticides in water bodies (such as DDT, heptachlor, lindane, fozalon and the like) have been recommended. The first stage of developing and standardizing norms for pesticide content

of foodstuffs has been completed. Between 1976 and 1980, unified, MDU's for 22 pesticides were established. Public health norms were developed and MDU values proposed for the mercury content of fish, meat, grain, vegetables and fruits have been proposed. MDU's for the organophosphorus pesticides difos (temefos), fenthion, kumafos and fenchlorofos in meat and milk products have been established.

In 1980, Yugoslavia developed norms for pesticide residues in foodstuffs and water and adopted a law on standardization, including agricultural pesticides. A draft on pesticides on and plant protection has been developed.

As part of the subtopic "Hygienic-Toxicologic Evaluation of Chemical Methods of Plant Protection," the standardization of maximum limits for pesticides in produce and foodstuffs exchanged between member countries has continued according to the concept that has been adopted (Institute of Public Health and Epidemiology, Prague).

Work is proceeding in the expectation that in future the exchange of goods between CEMA countries in and Yugoslavia will be increased and methods of chemical plant protection in these countries will be similar, while possibly differing considerably from those of other countries which are members of the Codex Alimentarius. However, it should be recalled that most of the CEMA states are also members of the Codex Alimentarious, and accordingly the individual CEMA members also make suggestions for the MDU's of the Codex Alimentarious as part of this subtopic. This will assure mutual interchange of information and at the same time will affect the establishment of MDU's for the socialist countries.

In addition, as part of this subtopic, MDU's for pesticides which have not yet appeared in the international Codex Alimentarious are being developed.

The question of a national or possibly two internationally recognized MDU's for pesticide residues is a legislative matter of great practical importance.

Exchange of information on methods of plant protection and MDU's makes monitoring easier and more economical.

Subtopic 1-8. XI. 3 can be described as a single task on which experts from all member countries are participating. The discussion of MDU's can be described at the subtask level. A total of 37 MDU's have been agreed upon for 21 pesticides; these may be considered relatively final proposals. An additional 48 MDU's are temporary and will be further discussed in the next 5-year plan (1981-1985).

The MDU's are being established on the basis of data provided by the individual CEMA countries and data from FAO/WHO and the Codex Alimentarious. Despite initial difficulties, primarily technical, the system of work has taken hold and has justified itself.

As its results we can cite the 37 agreed-upon MDU's, which can be used by the individual member countries for international trade between CEMA

countries and Yugoslavia. The same applies temporarily (for a maximum of 2 years) for the other 46 MDU's.

In 1981-1985, work in subtopic 1-8. XI. 3 will continue under the same designation with the title "Continuing Standardization of MDU's for Pesticide Residues in Foodstuffs and Feeds." This subtopic also involves MDU's only for commodities exchanged between member countries.

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CZECHOSLOVAKIA

APPLICATION OF ALTERNATE ENERGY SOURCES IN AGRICULTURE

Prague MERCHANIZACE ZEMEDELSTVI in Slovak No 1, 1983 pp 10-14

[Article by Eng Vladimir Kujan, Institute of Agricultural Design, Energy Division, Bratislava: "Nontraditional and Secondary Energy Sources in Slovak Agriculture"]

[Text] Employees of the energy division of the Agricultural Design Institute have been occupied with questions of the practical utilization of nontraditional and secondary energy sources in the agricultural-foodstuff complex of the SSR. The current situation in the use of these resources in our country, as well as proposals for both short-term and long-term measures in the sector administered by the SSR Ministry of Food and Agriculture, and the demands that this will entail for producers will be evident from the following article.

National economic development in every country is occurring under continually more complex internal and international conditions. The fuel and energy complex and the resolution of its most complicated interrelationships forms the basis for the development of each individual country. The assurance of a sufficient amount of energy resources is becoming world problem No 1. The economic policy and capital investment strategy we are currently implementing will influence the fuel and energy base of future generations.

The full extent of this reality has received its fullest confirmation in the Report Concerning the Main Directions of the Economic and Social Development of the CSSR National Economy in the Period 1981-1985," which outlined clearly the paths that will be followed by our fuel and energy policy during the Seventh 5-Year Plan, as well as in the more distant future.

In spite of the fact that maximum of attention is being devoted to the problem of assuring necessary fuel resources, an imbalance is increasing between demand and the available resources. This imbalance may be corrected only through across-the-board reductions in all national economic sectors and, to no small degree, by the use of nontraditional and secondary energy sources.

In view of the basic importance of assuring the future development of the national economy given limited availability of fuel and energy resources and the tautness of both domestic and external conditions, a state target program has been developed and approved which is directed toward the rationalization of the consumption and utilization of fuels and energy.

In the sector administered by the SSR MPVz [Ministry of Agriculture and Food], this program has set the goal of assuring the saving of 10,035 TJ [tera-joules] annually through rationalization measures by 1985.

This reality is forcing planners to think about the intensively search for ways to utilize waste heat as well as natural heat sources.

Utilizing Nontraditional and Secondary Energy Sources in Agriculture

The utilization of nontraditional energy sources has not yet been made viable for industrial applications. As long as fossil fuels were fairly inexpensive and there was no threat of supply shortages, little attention was devoted to research in nontraditional energy sources. This has changed only in the last few years when the limited nature of conventional energy sources has become apparent, as well as the possibility of exhausting them in the foreseeable future.

Solar Energy

The advantage of solar energy is that it not only supplements existing energy sources in a significant way, thereby contributing to an improvement in the current unfavorable balance, but also that it has a positive environmental effect in that it represents clean energy whose production does not generate byproducts that worsen the environment.

Currently, electrical energy consumption in the preparation of warm process water in the SSR amounts to about 75,000 MWh [megawatt hours] annually, and by the year 2000 this consumption is expected to increase to about 375,000 MWh annually.

The conditions for the utilization of solar energy in Slovakia are the best in south Slovakia and in the High Tatras, where the density of solar radiation delivers more than 1,400 KWh [kilowatt hours] of energy per year per square meter of surface.

The simplest and most widespread utilization of solar energy is the solar heating of process water. The heating of water with solar energy is, however, not recommended on dairy farms. On farms where milk is produced, it is most economical to use waste heat from milk cooling operations to heat water.

Overview of Current Situation in CSSR

In the CSSR, the practical application of the use of solar energy to prepare warm process water began in 1978. The first equipment was of an amateurish character, in the sense that its construction was not based on

a feasible tradeoff between energy savings and the payback period for the committed investment outlays. The popularization of this equipment in the daily and professional press, without having made an economic reassessment, did not fulfill its mission.

Solar collectors for the heating of water have already been installed at many agricultural enterprises. They are primarily amateur units with a low level of efficiency, systems that have been put together without regard for design fundamentals. And when a design is put forward, it is based on foreign data concerning meteorological and climatic conditions. In some instances, the collectors in use have been industrially manufactured (by Ceskomoravska-Kolben-Danek Dukla, the Kromeriz OPS [District Labor Center]). The quality of both products is poor, with that of CKD Dukla suffering from inefficiency and that of Kromeriz OPS from a short useful life. Moreover, the Kromeriz OPS has designed its product for personal use. The equipment is for the most part without regulators and its overall energy contribution does not correspond to the resources expended on it. The evaluation criteria for these solar systems is almost exclusively the temperature of the water obtained in the favorable summer months rather than the total heat obtained and energy saved.

CSSR Government Resolution No 121/80 designated the FMVS [Federal Ministry of General Engineering] as the producer of solar collectors. Within the FMVS, this task is being handled at the Strojsmalt VHJ [economic production unit], although the first deliveries are not scheduled until 1983. Contracts have been signed with the SSR Food and Agriculture Ministry for deliveries of 3,000 square meters in 1983, 6,000 square meters in 1984 and 16,000 square meters in 1985. At the same time, a state research project has been established at the above-mentioned VHJ, with the objective of providing for the development and production of more technically sophisticated solar systems by the end of 1986.

Preparation of Warm Process Water

The SSR Ministry of Food and Agriculture is intensively concerned with the utilization of solar energy. The Energy Division of the Agricultural Design Institute in Bratislava has developed a project entitled "Solar Units for the Preparation of Warm Process Water" for the dairy economy of Prusko. This project is currently being implemented, utilizing 92 units of Kromeriz OPS type SP80/08 Gu solar collectors, or 79,488 square meters of absorptive surface. The projected savings of electrical energy amount to 39,552 KWh per year, representing approximately a 48.7 percent annual saving of electricity.

The above equipment has been implemented as a pilot unit. Based on the results of measurement and practical experiences, an implementational stragegy will be developed and presented as proposed project documentation for the repeatable construction of units for the SSR agricultural sector.

Right now in the SSR, solar equipment for the heating of process water is in provisional operation at the Hubice State Dairy Farms, using collectors manufactured by the Ziar and Hronom Slovak National Uprising national enterprise. Additional solar equipment has been installed at the Modrany JRD, [Unified Agricultural Cooperative], the Vydrany JRD (an amateur installation), the Svodin JRD, the Michalovce State Farms and the Nove Zamky JRD (using collectors by the Strojsmalt VHJ). (See Figure 1)

Comprehensive Energy System for Covered Growing Space.

At the Mir JZD [Unified Agriculture Cooperative] in the Hradec Kralove District Agricultural Administration the heating of soil, irrigation water and process water will be implemented with solar collectors covering 800 square meters, heat pumps, and an LVO [Light Heating Oil] fired boiler. The payback period of the investment, given current energy prices is projected at 15 years.

Hay Drying

Solar-powered equipment for hay drying is being used at the Ponikla JZD in the Semily District Agricultural Administration. There will eventually be a total of 800 square meters of solar collectors, with an air flow volume of 88,000-100,000 cubic meters per hour. During the drying season the expected gain will be 850 Gj [giga-joules], given an average collector efficiency of 50 percent. The payback period for the investment is projected at 5 years.

Within the sector of the SSR MPVz the role of hay drying with solar energy has been established, the application of which is now being implemented in Velka Frankova and in Spisska Magura.

The collector surface is formed by a doubling of the roof casing. A space is thus created between the original and the new covering, a space through which heated air is conducted to intake conduits.

Heating Water for Fish Hatcheries

Tchthyological requirements for the hatching of fish in man-made tanks call for water at a temperature of 22-24 degrees Celsius. At this temperature mortality is very low, while at temperatures lower than 22 degrees Celsius mortality increases. Hatching in manmade tanks takes place in May and June. In view of the fact that the uninterrupted recirculation of water must be assured in these tanks during this 2-month period, solar energy may be used to regulate the water temperature. The Slovak Fisherman's Union is considering the use of solar energy for heating the water in hatching tanks in the next such period.

Proposed Short-term Measures

The proposed short-term measures include:

--the performance of an energy-economic analysis of selected solar equipment being used in the SSR MPVz;

--the designation of an organization which would be responsible for determining the level of need for installing solar equipment in a given locality in view of the payback period of the proposed investment and its effect on the energy balance;

--based on the ·esults of the evaluation of selected solar equipment beginning the experimental construction of comprehensive biosolar systems, for which an economic efficiency analysis should be performed with regard to savings of primary energy sources;

--the application of implementable research and development findings from the work of CEMA countries, the SAV [Slovak Academy of Sciences] and the UVSH [Institute for Application of Science in Agriculture] to our conditions;

--the inclusion in capital investment plans only of solar equipment for which the design work will be performed by an organization authorized to perform this design activity;

--supplementing the basic curriculum of agricultural colleges and higher schools with the scientific discipline of heliotechnology, with a focus on its practical implementation in agriculture.

Proposed Long-range Measures

These include the assurance of preparatory documentation for and the implementation of integrated solar systems and high-performance, large-scale, independent, central solar-thermal systems.

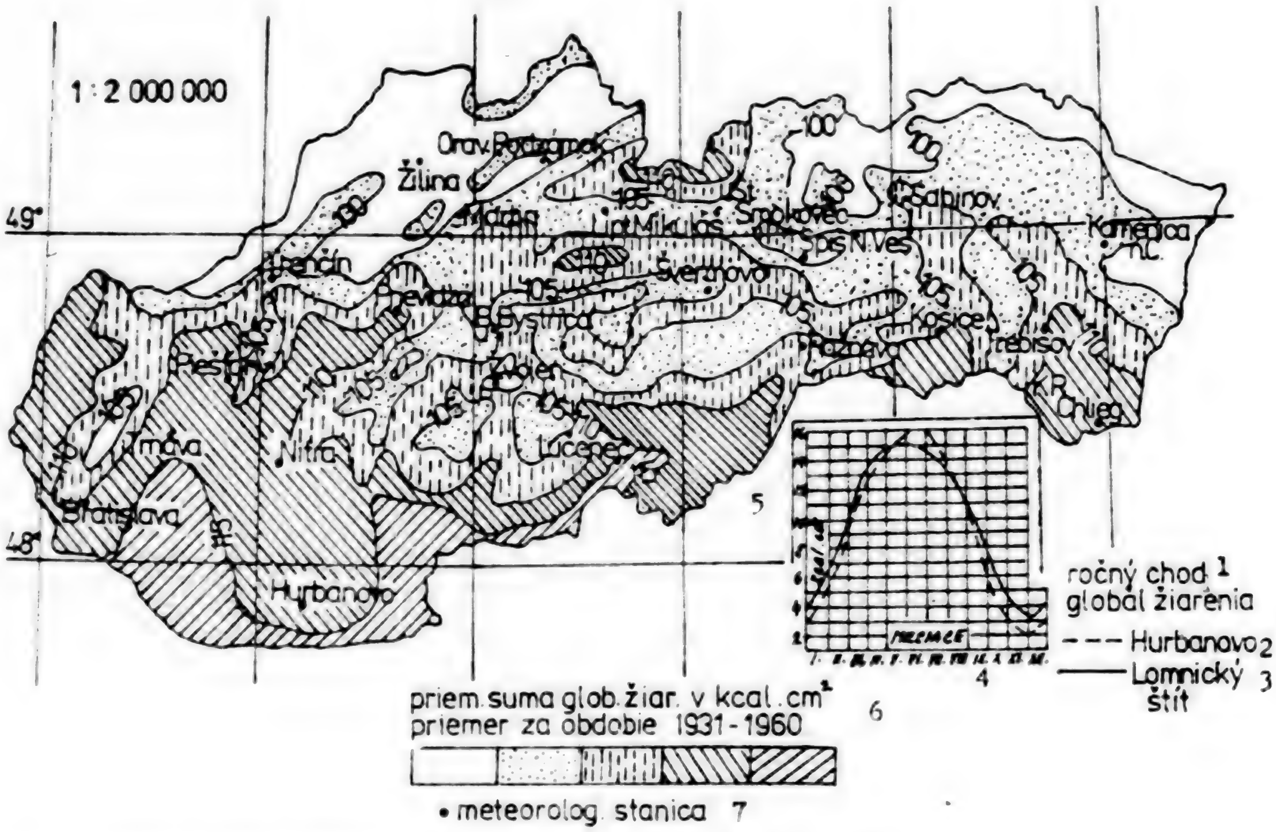
Integrated biosolar systems at large-scale farms would include solar collectors, recuperators and regenerators of the heat from the stables, equipment for obtaining heat from excrement and waste water as well as heat from cooled milk, consisting of a heat accumulator combined with exchangers, with differentiated consumption of warm water of differing temperatures. It is expected that these integrated systems will reduce aggregate procurement costs by 30-50 percent in comparison with costs of traditional solar systems. In addition, the efficiency of energy acquisition will be effectively raised, and thereby overall energy gain.

Demands on Producers

At present there is no mass production of solar collectors or of components for solar equipment.

Producers will be required to assure the mass production of solar collectors with a minimum efficiency in the summer months of 70 percent, of 35-40 percent in the winter and transitions periods, and with an overall average efficiency of the entire solar installation of 55-60 percent on a yearly basis. (see Figure 2)

Figure 2. Surface Solar Radiation in SSR, Average for 1931-1960 Period



Obr. 2. Globálne slnečné žiarenie v SSR, priemer za obdobie rokov 1931—1960

Key:
1. Annual course of surface radiation
2. Hurbanovo
3. Lomnicky Stit
4. Months (I-XII)
5. Kilocalories per square centimeter (2-16)
6. Average total surface radiation in kilocalories per square centimeter for 1931-1960 period
7. Meteorological station

At present, we do not produce circulation pumps appropriate for solar circuits. Such pumps must have rapid lifting capacity and be adjustable. The production of these pumps must be assigned to the Sigma VHJ. Likewise, the mass

production of temperature difference regulators must be initiated, since these determine the overall efficiency of a system and thereby the energy gain.

Geothermal Waters

The utilization of thermal energy from geothermal waters in Slovak agriculture is still in its beginnings. This is due to unsolved technical problems in addition to organizational and economic difficulties. Technical problems include complications arising from the chemical properties and mineral content of the geothermal waters obtained from a majority of the boreholes which have been drilled so far.

Between 1971 and the end of 1980 a total of 16 boreholes had been drilled, yielding 240 liters per second of water with an average temperature of about 68 degrees Celsius. Converted to thermal output, assuming a reduction of the temperature to 20 degrees Celsius, this represents about 40 MW. Based on findings to date, the utilization of geothermal waters located in Slovakia may be approached in one of two ways. In either case, the chemical composition of the waters and their mineral content is the determining factor.

The first technique: the direct utilization of the thermal energy in geothermal waters with a mineral content of less than 2 grams per liter of geothermal water.

The second technique: the utilization of the thermal energy of geothermal waters having a chemical composition and mineral content of more than 2 grams per liter of geothermal water, after this water has been processed.

The actual heating of greenhouses or temporary greenhouses must be resolved in two steps, i.e., in terms of the heating of space and of soil. The second of the above techniques differs from the first only in that it requires extra equipment for the treatment of geothermal waters with a mineral content of more than 2 grams per liter of water. Water that has been used may be released in compliance with conditions set by water management officials.

The multipurpose utilization of geothermal waters in agriculture must be preceded by a detailed analysis of the chemistry of these waters, with particular attention to the content of trace elements. Trace elements play, after all, specialized and positive roles in the physiology of organisms. In higher concentrations, however, they may exert an inhibiting or even toxic effect. Their presence may not be immediately evident, but may occur after some time. For these reasons it is necessary to call attention to the fact that geothermal waters may be, given higher levels of trace elements, a serious source of environmental pollution.

Current Status of Utilization in the SSR

The utilization of geothermal waters during the first half of 1981 made possible in Slovakia the conservation of more than 21 Tj which represents almost 1,450 TMP [tons of standard fuel] when converted to brown coal.

At present, geothermal waters are used in the following ways in agriculture:

--for the heating of .68 hectares of greenhouses and 1.8 hectares of temporary greenhouses at the Trhove Myto JRD;

--at the Podhajska Agrothermal for the heating of 2.5 hectares of greenhouses and 1.5 hectares of temporary greenhouses;

--for the heating of 1 hectare of temporary greenhouses at the Calovo JRD;

In 1982, construction was to have been completed on temporary greenhouses at the Tvrdosovce JRD which would make possible total savings of almost 17 Tj. Construction was begun on greenhouses at the Horna Poton JRD that would make possible annual savings of more than 17 Tj.

Proposed Measures

--The development of a proposed solution for geothermal water utilization at Kralova pri Senci, where preliminary estimates indicates that it would be possible to heat about 0.6 hectares of greenhouses;

at Komarna, where there is the potential to heat greenhouses covering 0.13 hectare;

at Sturova, for the operation of greenhouses covering almost 2.0 hectares.

--The development of a solution for utilizing geothermal waters at Topolnik, Galant, Tvrdosovce, Dunajska Streda and Podhajska, where mineral content is in excess of 2.0 grams per liter, with the objective of increasing the area covered by greenhouses and temporary greenhouses from the current 6.4 hectares to 9.68 hectares.

--Creating the conditions for implementing a reduction in mineral content, as operationally verified at the Dunajska Streda District Agricultural Administration in conjunction with the chemical factories at Novaky.

--Thoroughly study a system for utilizing geothermal waters in the People's Republic of Hungary, and to apply the results obtained to the SSR.

Waste Heat from Nuclear Power Plants

The further economical development of agricultural mass production with a view to assuring the independence of the CSSR regarding sources of food and bringing about a change in the structure of the diet by increasing the consumption of vegetables, fruit, fish, poultry and veal, eggs, milk, and milk products involves very energy-intensive processes. On the other hand, the national economy loses immense amounts of heat that existing condensation power plants must waste either by dispersing it into the air or bodies of water. The volume of this as yet unutilized energy in the form of waste heat from the cooling cycles of power plants increases with increased output and emmissions concentrations in a given locality.

The amount of unutilized energy in the form of so-called low potential (waste)--secondarily usable--heat occurring in the cooling cycles of these power plants, is growing throughout the CSSR. At existing fossil fuel power plants, this unutilized heat represents 48-52 percent of the thermal output of the boilers, while at nuclear power plants of the VVER 440 and VVER 1000 type the abundance of this heat is still greater, representing up to 70 percent of the thermal output of the nuclear reactor. For instance, the projected value of the secondary, utilizable heat from the Jaslovske Bohunice nuclear reactor is 5500 MW, in almost uninterrupted operation over the past 25 years. (note from translator: 25 years probably a type, since Jaslovske Bohunice planet not really that old; 2.5 years more likely)

The VVER type nuclear power plants assure a sufficient concentration of occurrences of all categories of thermal energy, but especially of low potential heat. The technical design and operating conditions of nuclear sources make possible year-round, stable deliveries of heat, eliminating the need to construct reserve sources.

The basic conditions are thus being created in our country for the design of multipurpose nuclear energy sources, through the utilization of significant amounts of this secondary energy resource in the intensification of agriculture.

In the Seventh 5-Year Plan, nuclear power plants will account for almost 75 percent of the planned increase in electrical energy production. By 1985 alone, construction is projected of nuclear power plants with an installed capacity of 3,529 MW, which will replace 17-18 million tons of brown energy coal annually.

Prospects for the Agricultural Utilization of VVER Type Nuclear Power Plants in the Vicinity of Mochovce.

The Kraj Central Heat Supply System (SCZT) includes the cities of Levice, Nitra, Vrable, Tlmace, Zlate Moravce, and Nove Zamky. According to the design proposal for a secondary EMO [Mochovce Power Plant] circuit, it is possible to count on a total heating capacity in the hot water of 130/60 degree liters at a level of 1,020-1,265 MW tons, without an impact on planned deliveries of electricity to the central electrical system and while continuing to assure the operational reliability of heat supplies from nuclear sources.

Of the potential heating capacity of the resources in this area, communal and industrial demand in the SCZT is projected to reach 480 MW tons (5,704 Tj per year) by 1995, with a target of 701 MW tons (8,480 Tj per year), meaning that the remaining thermal capacity may be used by the national agriculture-foodstuff complex, and specifically by concentrated producers in particular regions. Moreover, there remains in this area the possibility of applying over large areas low potential heat of categories I and II to the intensification of plant production and fish husbandry in heated water.

Verification of the Agricultural-Foodstuff Base of Jaslovske Bohunice

Prior to the decisionmaking process for the implementation of both noninvestment-intensive and operationally demanding facilities for the agricultural-foodstuff complex utilizing all categories of heat obtained from VVER type nuclear power plants, government organs have decided to construct an agricultural-energy-generation testing facility at the nuclear electrical generation complex at Jaslovske Bohunice, following essential operational and economic tests.

The completed project study includes a proposal for the routing of waste heat from the nuclear power plant, the building of a greenhouse complex, the subsurface heating of open growing beds and temporary greenhouses, the construction of equipment for intensive pisciculture, including economic controls. Given the requirements of the agricultural sector, this facility should be constructed so that its operational reliability, hygienic safety, and the economic viability of the entire system may be evaluated.

The facility should be built between 1982 and 1985, with individual components becoming operational beginning in 1983. At the same time, approval was obtained for including certain as yet unsolved problems as projects in the state plan for scientific and technical development. For instance, the Hurbanovo research and enrichment institute for vegetables and special plants will be working, in this 5-year plan, on a long-term project entitled "Utilization of Waste Heat from Energy Generation and Industrial Enterprises for Plant Husbandry." The Praha-Repi Research Institute for Agricultural Technology is the coordinator of the project "Utilization of New Energy Sources in Agriculture and the Food Complex," and the Vodnany Fish and Hydrobiological Research Institute has been working since 1979 on the project "Development of Fish Husbandry with Special Attention to Waste Heat Utilization."

In accordance with a decision of the CSSR FMTIR [Federal Ministry of Technological and Investment Development] and an agreement among the SSR MVT [Ministry of Development and Technology], the SSR MPVz, and the CSSR FMPE [Ministry of Fuel and Power], technicoeconomic studies have been prepared for the state development of RVT [Science and Technology Plan] No S 11-529-059-09, "Utilization of Waste Heat from Condensation Electric Power Plants to Increase the Intensity and Efficiency of Agricultural Production." The extent of the work on this state project is governed by its main objective--the operational and economic verification of possibilities for the large-scale utilization of low potential heat to intensify agricultural production.

Timewise the project has been divided so as to yield outputs from 1985 to 1987-88, when the project ends. The time frame for obtaining the specific bases for large-scale utilization throughout the CSSR is tied to, and conditional upon, adhering to a schedule stipulating the construction at the facility of the main structures for providing thermal amelioration by 1982-1983, and the completion of the greenhouse system

and auxiliary operations by 1984 at the earliest. Work on the fish husbandry compound of "The Base" will proceed so that by 1985 an industrial schedule can be implemented and so that it will be possible at the same time to make use of the results of this state project to make conceptual decisions regarding the siting of future nuclear power plants, especially the Mochovce nuclear plant.

Measures to Assure the Implementation of Objectives

The following measures have been proposed to assure the implementation of conceptual proposals for the utilization in agriculture of heat from the Mochovce nuclear power complex and the SCZT of the Nitra-Levice large territorial unit, as well as from the Jaslovske Bohunice nuclear power plant and Jaslovske Bohunice-Trnava heat pipeline.

Short-term Measures

--develop a program for the utilization of all categories of hot water from the Jaslovske Bohunice nuclear power plant;

--construct an agricultural-food industry testing facility in Jaslovske Bohunice;

--construct a greenhouse complex along the Jaslovske Bohunice-Trnava heat pipeline by the time this pipeline is to become operational, and work out a proposal for the potential siting of agricultural drying operations (for bulk fodders and grains) in this area;

--provide for the undertaking of comprehensive studies on the utilization of all categories of heat from the Mochovce nuclear power plant and from the Nitra-Levice SCZT in the agricultural-foodstuff complex. Make use of the recommendations of these studies in forming a plan for "The Development of the SSR Agriculture-Foodstuff Complex Until the Year 2000;"

--subordinate the siting of new factories of the agricultural-foodstuff complex above all to considerations of energy coverage in the vicinity of nuclear power plants;

--cooperate systematically on the solution of state RVT Project No P-09-159-407, "Environmental Improvement and Protection Given the Comprehensive Use of Nuclear Energy."

Long-term Measures

--based on the information from the testing facility at Jaslovske Bohunice, utilize in a preliminary way the results of operational and economic testing, as well as the potential for the large-scale utilization of low potential heat for the intensification of agricultural production;

--continue to develop proposals for the utilization of heat of all categories from the nuclear power plants and Kraj SCZT systems in Slovakia, and systematically integrate them into long-range plans for the development of the agricultural-foodstuff complex of the SSR.

9276
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SZEKER SPEAKS ON ACHIEVEMENTS, PROBLEMS OF TECHNICAL DEVELOPMENT

Budapest MAGYAR HIRLAP in Hungarian 19 Feb 83 p 5

[Interview with Dr Gyula Szeker, chairman of the National Technical Development Committee, by Erika Zador: "The Basis Is Good Technology"; date and place not specified]

> [Text] Dr Gyula Szeker was born in 1925. He received his diploma in chemistry from Lorand Eotvos University, Budapest, in 1950, became a science candidate in 1953 and gained his doctor of science degree in 1971. He worked as engineer in various areas within industry. From 1956 on, he was deputy minister, minister, and deputy premier. Since 1980, he has been the chairman of the National Technical Development Committee. He authored several books on the technical and economic problems of industrial development.

Practically all one hears these days is how difficult the economic situation is, all the things there is not enough money for, and how important it is to economize. Not a penny may be spent unnecessarily. The most important objective is the expansion of export and restoration of economic equilibrium. Everything else must be subordinated to this objective. And because scientific research and technical development do not serve this objective directly, many people believe that research and development should now be cut back somewhat.

Zador Erika, a member of our editorial staff, interviewed Dr Gyula Szeker, the chairman of the National Technical Development Committee, on the true role of scientific research and technical development and of raising the technological level, specifically now, and on what has been the contribution of research and development to our results.

[Question] The Science Policy Committee recently considered the long-range concept of scientific research and technical development. Naturally, you as chairman of the National Technical Development Committee favor research and development. But from your writings and speeches it is evident that your support of development is motivated also by the experience that you have gained as engineer and politician. At the bicentennial of Budapest Technical University, the eminent Hungarian chemist Vince Wartha said: "We will never have an industry for our own benefit if we wish to develop it solely with foreign help and foreign capital."

[Answer] On that same occasion I referred to American experts, in whose opinion technical development is as important for them as oil is for Saudi Arabia; and

to the French who regard innovation as the absolute weapon. Economic history proves that technology is renewed after each recession. You can see also now how much effort the developed capitalist countries are devoting to research and technical development. They want to market new products for which there is demand, in spite of lower personal consumption and accumulation. They are seeking new technologies with which products can be produced cheaper, with less direct labor, materials and energy, and therefore the products will be more competitive. If we do not want to fall behind for good, then we too must develop both our products and our production. Of course, it is not all the same what we develop and how. Modernization of production and of the product structure is a long-term process and requires foresight. A fundamental task of economic policy at any given time is the deliberate modernization of this process, its modification to bring it in harmony with the given historical, social and economic processes.

[Question] Development is an extremely complex task. But the question arises as to where we must develop, and from what.

[Answer] The enterprise is the basis of development, just as of production. We believe that if we hold the enterprise responsible for its products and their marketing, then decisions regarding development cannot be taken away from the enterprise. Research and development is financed from the technical development fund that is formed at each enterprise, from the centralized portion of these funds that is administered by the ministries and the OMFB [National Technical Development Committee], and also from bank credit and budgetary grants. One way the state exercises influence is that the centralized technical development fund and bank credit are made available to those enterprises whose development is proceeding in the directions specified by economic policy.

Incidentally, I would like to use this opportunity to dispel a misconception that frequently crops up even in the press. Specifically that in our country research and development is divorced from production. It is indisputable that for a long time the research institutes that had been established separately from the enterprises did not serve industry's needs, but during the past 15 years the situation has changed significantly, due specifically to the pressing circumstances. A third of the development personnel is in the plants themselves; another third is at research establishments that cooperate closely with industry. And here I have in mind not only the high-level industrial research institutes or certain institutes of the Hungarian Academy of Sciences, but also the university departments. It is in the vital interest of these departments to praticipate in technical development as intensively as possible.

And let me refer also to something about which relatively little is being said lately: the command staff of production, the development and research engineers and scientists also have a human need to produce. Who lacks this desire for human desire for achievement, who measures everything in forints, is not a real expert in his field.

[Question] In this I agree with you completely. But I do not know how long we can base technical development on the unquestionably existing positive human traits and noble determination.

[Answer] The question of the technical intelligentsia's remuneration is constantly on the agenda. But the present economic situation does not allow a general increase of salaries. If for no other reason, because the size of the technical intelligentsia has increased from 10,000 in the early 1950's to 15-fold at present. In general, we cannot speak of a shortage of technical cadres. But there is a shortage of creative people, of good managers. The pseudo-humanistic practice of selecting managers--in the interest of the individual's well-being it often hampered the collective's development and the improvement of efficiency--led to difficulties that are all too familiar. In spite of this, Hungary has produced very noteworthy results also in technical development, which can be attributed in no small extent to the activity of the technical intelligentsia. I would single out first of all food production as an area in which our country's specific indicators rank among the best in the world. And I mention food production especially to point out the complexity of technical development, the interdependence of various industries and of agriculture and the food industry.

Agriculture needs manufactured fertilizers, plastics, feed additives, and many other kinds of materials. These can be produced only by a developed industry. This is why it was necessary to develop the fertilizer industry and the plastics industry. At present our industry is producing about as much plastics as we are consuming. The convertible foreign exchange spent on the development of the plastics industry was recovered twice over under the 5th Five-Year Plan, and we are expecting similar results under the current 6th Five-Year Plan. The starting material is produced domestically and imported from socialist countries. However, the output of the plastics industry matches consumption only in volume, but not in their structure. Therefore, we are exporting a proportion of the starting materials for plastics, and are importing in exchange products that cannot be produced economically at home. The fact that we developed specifically the domestic production of PVC was not simply a matter of decision; it was a requirement stemming from the structure of the Hungarian economy. The truth of the matter is that the aluminum industry needs caustic soda, and chlorine and caustic soda are coproducts of the electrolysis of brine. We are using this chlorine to produce PVC. It is indisputable that the development of capacities in plastics fabrication is lagging behind the plan, but we will gradually eliminate this lag and will soon be able to supply entirely from domestic production the plastic elements used in industry and construction.

[Question] You mentioned aluminum as an important Hungarian raw material. At one time this metal was readily marketable, but now its prices are depressed. Will it still be worth while to develop its production as planned?

[Answer] Unquestionably. The depressed prices merely mean that the profit now is less than what it used to be. The alumina produced from domestic bauxite with domestic soda, and the aluminum smelted within the framework of international cooperation are profitable. Our aluminum industry is a locomotive of technical development, one of our largest foreign-exchange-earning industries. And at this point, allow me to say a few words about petroleum and natural gas production in the Alfold [Great Plain], which has been made possible by extensive scientific research. These fields are now producing 1.0 billion dollars' worth of hydrocarbons annually. It is terrible even to think of what would happen if we had to import even this volume. At present the Szeged hydrocarbon field is the country's largest mine. In terms of calorific value, its output is more than the entire coal output of the Transdanubian Region. The coordinated development of the mentioned industries and of agriculture and the food industry has

contributed significantly toward the improvement of the quality of life that has taken place before our very eyes. Natural gas, in some form, is available practically everywhere in Hungary. Retail trade is offering farm produce prepackaged in plastic. A deliberate concept of research and technical development must never lose sight of everyday problems. We are now debating the master concept of developing science, technical development, industry, agriculture and the food industry, the construction industry and the building materials industry, international cooperation, the infrastructure, the standard of living, regional development and environmental protection through the year 2000, taking into consideration also the very strong interactions between branches. Naturally, the lessons derived from this concept that has been prepared with the participation of several hundred experts will be utilized also in drafting the 7th Five-Year Plan.

[Question] Today when the economic situation is so variable, to what extent is long-range planning justified? For example, what would a long-range technical development plan look like?

[Answer]. We are speaking not of a plan, but of a concept. After careful deliberation, the concept identifies only the directions in which it is worth while and necessary to proceed. Such a guideline is sorely needed so that our economy will not merely respond to events, and that we may purposefully formulate our technical development policy tailored to our possibilities, in accordance with the foreseeable trends.

1014
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UNIVERSITY NUCLEAR RESEARCH REACTOR DISCUSSED

Budapest NEPSZABADSAG in Hungarian 24 Feb 83 p 4

[Article by Istvan Safran: "A Reactor Leak is Out of the Question"]

[Text] I suspect that only a few people within the country are aware that at present not just one reactor--the one at Paks--but two are in operation along the Danube. The other and smaller one hides behind Building R of the Budapest Technical University. Hundreds of students and instructors pass it daily but only a few of them are able to pass through the door secured by a double electric lock.

As we fill out the 21 items of the questionnaire needed to obtain the permission to enter, I tell to Dr Gyula Csom, director of the reactor, that I realize why I have to be patient: "I do understand that special safety and protective measures are required; after all, the atom is not a child's play...."

"You should not be scared and should not overestimate the problem. Consider this reactor, if you please, as only one of the more than dozen laboratories of the Technical University. In this place we are dealing also with materials, even though they have different properties and therefore we must use different tools...."

The Power of Two Lada Cars--from Uranium

Dr Gyula Csom has served from the beginning as the director of the reactor. The installation was only at the design stage when a competitive examination was held, resulting in the selection of the then 35-year-old young man. The decision was greatly affected by the fact that he has participated both in the design and the construction and therefore, if you will, he knows every single brick in every nook and cranny of the building. As we are walking toward the sphere-shaped reactor, he imparts to us some basic textbook knowledge.

So, what should we know about all this?

"The first reactor was started up 40 years ago in the United States, with the collaboration of several of our compatriots, including Eugene Wigner and Leo Szilard. About 10 years later the first power plant started to operate in the

"Soviet Union. Another date should be mentioned: since about 1970 the power generated by fissionable materials is considered economical.

"Our first reactor was built in 1959 at Csillebercon the basis of Soviet plans and in a predominantly Soviet execution; however, training of the specialists was started several years prior to that date, and accordingly the experimental reactor was designed during the period from 1967 to 1971 by Hungarian experts.

"That was just about the time when the construction of the Paks reactor was decided.

"Indeed; the experimental reactor which cost 50 million forints until it was turned over to us, represented the first stage of that project. You will meet people past middle age when you visit the building. These are the early graduates, who are now receiving the call to work at the nuclear power plant and are trained by us to be ready for their new assignment."

"Is it not unusual that such a, so-to-speak, special plant is installed in the very heart of the city?"

"What you are thinking of is a fallacy. The so-called accident of a reactor leak cannot occur because the reactor is a self-throttling system. Moreover, the output of the whole installation does not exceed 100 kilowatts. This is approximately equal to the power rating of two Lada cars. On the other hand, it is true that it operates exactly as the Paks reactor, the output of which is 13,000 times larger."

The Radiation Is Blue

After we have passed the two automatic barred doors, we don white lab coats, cover our shoes with plastic bags and place into the breast pocket an automatic dosimeter and a small box with a sheet of film which blackens under the influence of radiation. Everybody who enters the facility must carry these detectors. There is no exception. The reactor presents a fascinating spectacle. It is placed in a two-meter thick, concrete block, in a 1.40-meter diameter, cylindrical aluminum container. From above we can actually see, not only imagine the processes which take place in it. The core is covered with five-meter high column of extremely pure water but the movements of the manipulators supervised from the control board can be easily followed. When the bottom illumination is turned off, the cells glow with a bluish light.

"It is possible to interfere in the processes which take place below not only from above but also by opening certain horizontal tunnels"--tells us Sandor Porkolab, the operator. "The largest of them is protected by a 7-ton concrete gate; behind it is located the thermal column which can be moved with the help of a carriage."

"Aren't we foolhardy to be so close?"

"Vessels containing a boron solution are shielding the beam."

We learned that all our steps were followed by electric eyes; we are kept under surveillance by closed-circuit TV. In any case, the reactor building is not a passageway but it is still desirable to ensure discipline and order in this manner. The operator glances at his watch and tells us that a lecture will be presented soon; the reactor will be started up soon for the benefit of a group of engineers arriving from Paks and he must make the necessary preparations. He suggests that if we are interested in the start-up we should meet him in half an hour in the tower.

Beyond the Critical Point

Thirty minutes later Sandor Porkolab leans back with satisfaction. He completed the check-up operations, making all instruments and devices ready to operate--if only for a short period. He gives the signal: Ready to start!

"First we send in the starting neutron source" (he explains to us what he is doing, while he pushes a multitude of buttoms, just like a pianist playing on his keyboard). "The neutron source plays the role of a match for starting a boiler. The free particles--the neutrons--which initiate the reaction of the fissionable material, are streaming out from it."

A green signal lights up on the tabulator, indicating that the first phase of the start-up process has been completed. Then, with the help of manipulators he removes the two so-called safety rods. These units, consisting of boron carbide, possess a very large capacity to absorb free neutrons and thus keep the reactor at a standstill, like a brake. Here it is simply impossible to make a mistake. Three sets of 24 lamps provide information to the operators about the state of the reactor. The blue lamps advise him what takes place at a given moment, the yellow lights reveal the exact location of errors, and the red lights indicate an emergency situation.

"Did it ever happen that one of the red lamps was on?"

"Of course--for example when we give a wrong command to the automatic system. In such a case, if the red lamp lights up, the reactor is automatically shut down."

In the meantime, they start to raise the two, so-called manual, regulating rods. When they are in the zero position, about 600 mm are immersed into the reactor, and as they start their upward course, the reactor comes alive.

"This is the subcritical state"--says the operator, pointing to the indicator--"that is, the nuclear process has been initiated within the several meters thick concrete vessel, under the five-meter high column of water." As he gives further commands, the control rods are lifted out and we reach the point of criticality, at which the processes taking place within the reactor reach the self-sustaining level. The start-up of this process is signaled by an occasional discontinuous blast of the whistle. The chriping noise becomes faster and faster, the indicators on the instruments go higher and higher: the self-sustaining chain reaction within the pile keeps accelerating and the sharp sound becomes practically continuous.

"This is the supercritical state"--explains the operator. "From here, the peak performance can be reached within seconds."

The Special Ore

We experience an odd shiver: we are squatting on top of a pile, the operation of which we understand--albeit roughly--and still perceive it as something mysterious and distant. This is a miraculously exceptional event: a meeting with the future.

"What makes all this go?"

"There are about 30 kilograms of uranium within the reactor"--the director tells us, indicating the approximate position on this side of the concrete block. "We installed the materials 12 years ago and there is still no indication that any of the cells should be replaced or replenished. Therefore, we do not have any problems with waste materials. One-tenth of the uranium in the reactor consists of the so-called 235 type. Its function is to split when exposed to the previously-mentioned neutrons, thereby releasing energy. In this process, an average of two and a half neutrons are formed in each of the fissioning events and one or the other of them induces another fission.

"Is uranium-235 a special ore?"

"It is one of the components of the naturally occurring uranium. It is first enriched. We could call it 'sorting' but the isotopic enrichment is a much more expensive process. We are not prepared to do this; even the Federal Republic of Germany could do this only in association with others."

The demonstration is over; the Paks detachment has arrived. The operator reinserts the neutron-absorbing rods into the reactor and removes the two starting keys. The key used to switch on the main current and to regulate the voltage of the magnets which hold the uranium rods is placed in the safe. While we put on our street clothes, we just had to ask: "Is this the way the military nuclear fission takes place?"

"The nuclear fission is an identical process; however, it is under control in reactors and power plants. On the other hand, the bomb is only initiated."

"You mention power plants and reactors; what is the difference?"

"As its name indicates, the power plant--such as the one at Paks--generates electric power. On the other hand, in our case the reactor is only an operating model, possessing all its advantages and of course, also requirements. Our installation has many applications, in addition to training. A broad range of research activities is carried out within the building; for example, geologists or biologists often turn to us, asking us to determine the origin, age or composition of materials. Different materials react differently to radiation and this makes it possible to determine where they belong."

"What happens to the thermal power generated there?"

"It is cooled." There is no need for it. They have enough power for that purpose....

2210
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DEVELOPMENT PROGRAM FOR INDUSTRIAL ROBOTS DESCRIBED

Bucharest CONSTRUCTIA DE MASINI in Romanian No 10, Oct 82 pp 519-521

[Article by Dr Aurel Sandu, Dr Tiberiu Vasilescu, Dr Ion Mazilu, and Eng Petroniu Breseanu, ICSITMUA (Institute for Scientific Research and Technologic Engineering for Automatic Machine Tools) Titan, Bucharest]

[Text] A significant role in the rapidly growing labor productivity is currently being played by extensive mechanization and automation (particularly in labor intensive sectors, in dangerous environments, in metal cutting areas, and so on) through the use of manipulators, industrial robots, and microprocessors.

In the relatively subjective understanding of specialists, manipulators are defined as mechanisms with 3-4 degrees of freedom, with rigid operation cycles, and usually with adjustable end points. These characteristics lead to the primary utilization of manipulators in mass production, requiring complementary mechanisms which place and remove parts one by one, at rigorously determined positions. Changes of products or of technical processes require the redesign of the entire system.

Unlike manipulators, industrial robots with flexible controls are defined as multifunctional systems, designed to perform programmed and continuously controlled motions for handling materials, parts, tools, or special devices in order to fulfill a broad range of tasks in technical processes. Changes in parts (or technical processes) require reprogramming of the robot, with few or no modifications to the system. Industrial robots are designed for applications in manufacturing families of parts, or for inclusion in complex technical processes where the use of manipulators is not possible or economical because they would require repeated interventions for costly adjustments.

Industrial robots replace human labor on jobs:

Which are carried out in toxic or dangerous environments unsuited for human activities;

Which involve loads that are heavy or difficult to handle;

Which consist of repetitive, boring, and tiring operations.

As an efficient means for automating production, that can adapt readily to changes in the parts to be handled (flexibility with respect to time), or in the motions of the parts (flexibility with respect to space), industrial robots are used in the following applications:

Automatic loading and unloading of different materials from pallets or containers;

Automatic loading and unloading of ovens and heat treatment baths;

Automatic loading and unloading of machines and tooling that perform unusual technical operations;

Automation of specific operations (bead or spot welding, painting, protective coating of materials, feeding, polishing, and deburring);

Automatic assembly of components or complete units;

Automatic control and measurement;

Automatic sorting, storage, and transfer of parts.

The use of industrial robots offers a number of advantages, such as:

Possibility of reutilization due to outstanding flexibility, a quality which results in savings of materials and time;

Possibility of increasing labor productivity by minimizing the duration of operations, which can be performed at the fastest optimum speed required by processes;

Capability of operating 24 hours per day, thus substantially increasing the investment efficiency of costly equipment and installations;

Minimum consumption of materials (welding, painting) through accurate and uniform repetition of motions, while increasing the lifetime of tooling (welding equipment for instance);

Reduced number of work accidents and work-connected illness throughout the economy, by replacing human operators on jobs that are highly dangerous or that demand outstanding physical or attention efforts.

At the same time, industrial robots represent indispensible means for building flexible machining centers and for creating in the foreseable future, unmanned shops and enterprises.

The ICSITMUA-Titan program has been concerned with the development of a range of standing and gate manipulators, and of two types of flexible control industrial robots; these are:

MM-10 standing manipulator designed for automatic feeding of parts of revolution (with a maximum weight of 10 daN and an l/d ratio of 0.1-1) to horizontal axis machine-tools, such as conventional, turret, facing, and other lathes;

MM-25 standing manipulator designed to handle disc-shaped parts with a diameter of 100-350 mm and a maximum weight of 25 daN. In automatic cycle, it performs simple motions of part grasping, vertical lifting, horizontal arm approach, and 120 degree rotation in the horizontal plane;

MP-10, MP-25 and MP-40 gate manipulators designed for feeding machine groups with horizontal or vertical axes (lathes, grinders, borers, combination machines, transportation between moving belts, and so on);

Ric-25 industrial robot with displacement in cylindrical coordinates, used to automate auxilliary technical processes of the take-put type, which most often are unpleasant and boring for human operators.

Because Ric-25 is equipped with a minicomputer, it can perform complex control functions as part of long programs, which enable users to solve difficult problems without the additional costs of peripheral equipment design.

The motion slides of the Ric-25 industrial robot are powered by direct current motors (produced by ICPE--Research and Design Institute for the Electrotechnical Industry and by IAUC--Enterprise for Research Instruments and Equipment) which have low maintenance costs and rapid positioning.

The system is designed so that the robot itself and the control equipment can be separated to form two distinct units.

The control unit (produced by IPA--Automation Design Institute and by Automatica) together with the direct current motor servoamplifiers, are housed in a single cabinet. This means that the robot itself is relatively small and easily mounted, while the control equipment can be located separately and protected from harmful environments.

Ric-25 is equipped with two large assemblies, depending on the type of motion and positioning it offers:

a) Regional positioning motion that takes place in a system of cylindrical coordinates:

   Rotation around a vertical axis (phi),
   Translation in a vertical plane (z),
   Translation in a horizontal plane (y);

b) Local positioning motion of the articulation:
   Rotation around an axis perpendicular to the arm axis (beta),
   Rotation around an axis perpendicular to the beta axis (theta),
   Rotation around an axis perpendicular to the theta axis and contained in a plane parallel to beta (alpha).

All these six degrees of motion are controlled within the coverage zone.

The boundaries of the coverage zone are determined by electric delimiters and mechanical stops, while zero positions are determined electrically in order to establish origins for travel measurements.

Positioning on each coordinate is achieved with incremental rotary translators--TIRO, produced by CCSITMFS and IOR (Romanian Optical Industry).

The mechanical subsystem includes the robot's support structure and the mechanisms which transform the motors' rotation into the motion required in the given direction.

The control program is stored in memory. This fixed program tells the computer how to carry out control instructions and functions.

The computer directs and organizes input and output signals between the control and processing systems.

The motion of the robot along a particular path is programmed by teaching with the programming unit.

A program stored in memory can be started, stopped, or repeated continuously by an operator at the control console.

The industrial robot with motion in spherical coordinates, Ris-63, is intended to automate technical processs of the take-put type, making it possible to orient human manpower toward more creative activities.

Like Ric-25, Ric-63 has computerized control equipment, and can perform complex control functions as part of long programs, thus enabling users to solve difficult problems wihtout additional costs for equipment design.

The motion mechanisms of the Ris-63 are powered by hydraulic rotary servomotors and cylinders, which have minimal maintenance costs and are quiet.

The system is conceived so that the robot itself, the control equipment, and the hydraulic pump can be separated to form three distinct units.

Ris-63 is equipped with two large assemblies, depending on the type of motion and positions that are required of it:

a) Zone positioning motions in a spherical coordinate system:

Rotation around a vertical axis (phi),
Rotation in a vertical-rocking plane (beta),
Translation of the arm (y);

b) Motions for local positioning of the articulation:
Rotation motion around the axis of the arm (theta),
Rotation motion around an axis perpendicular to the axis of the arm (alpha).

All these five degrees of motion are controlled within the zone. The boundaries of the three major motions (regional positioning) are controlled by electric delimiters and mechanical stops with hydraulic dampers.

All five motions have electric delimiters to establish zero positions as origins for travel measurements.

The control subsystem consists of the computer, memories, inputs and outputs, interfaces to peripheral equipment, and control functions of the measurement subsystem.

The power subsystem consists of a hydraulic panel equipped to supply the robot's hydraulic power.

The motion control subsystem consists of servo-valves installed on rotary hydraulic motors and cylinders.

Positioning along each coordinate is achieved with incremental rotary translators of the TIRO type.

The mechanical subsystem includes the robot support structure and the links that provide the five motions.

The control program is stored on disc memory.

The operator and the control system communicate through a control console and programming units. The computer directs and organizes input and output signals between the control and execution systems.

The robot's motion along a particular path is programmed by teaching with a programming unit.

The program stored in memory can be started, stopped, or repeated continuously by the operator at the control console.

In the next years, the ICSITMUA-Titan program includes a generation of adaptive industrial robots equipped with:

Sensing systems for force control;
Visual feedback systems;
Facilities for recognizing shapes and positions;
Facilities for recognizing the human voice.

The use of these so-called second generation robots will have important economic consequences insofar as they will obviate the need for auxilliary mechanisms for feeding, sorting, and orientation, which are expensive and cause the system to be rigid, and will completely exclude human operators from the production sector.

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